

## APPENDIX

1. (Currently Amended) An article of manufacture comprising computer usable medium having computer readable program code means embodied therein for causing a relationship to be implemented within a database using BitSets, said program code being stored in computer readable memory or storage device, the computer readable program means in said article of manufacture comprising computer readable program code means for causing a computer to effect:

A.) ~~Defining~~ defining a database scheme;

B.) ~~Quantify~~ quantify a relationship among a plurality of entities;

~~C.)~~ Populate populate said database with instances of independent relationships among said entities and concurrently populating said database with Bitsets, inserts, deletes and/or changes, there being constraints on the number of keys in the BitSet to allow database integrity thus disallowing incorrect relationship data from being entered into said database, there being associations stored in the form of said Bitsets free from dependency on attribute data values;

D.) ~~Submitting~~ submitting an explicit query for desired information so that said database performs evaluation of said query using said Bitsets, said Bitsets being of variable length and prepopulated based upon associations, said query processing being independent of data values, said query for desired information being queries for categorization involving retrieving entities associated with all levels, with a single query using column functions for relationships and Boolean Rule evaluation using a method selected from the group consisting of iteration of recursive queries, confirmation of existence of or count of entities in the relationship;

E.) ~~Database~~ database generates a resultant set;

F.) ~~Resultant~~ resultant set returned to a requestor;

G.) ~~Repeat~~ repeat steps as D through F until a recursive association under consideration for said resultant set is exhausted, said steps for causing a relationship to be implemented within said database using BitSets being free of indexing.

2. (Currently Amended) The article of manufacture as recited in Claim 1, the computer readable program code means in said article of manufacture further comprising computer readable program code means for causing a computer to effect an independent query to said database and said data base transforms said query to a ~~bit-set~~ BitSet query.

3. (Currently Amended) The article of manufacture as recited in Claim 1, the computer readable program code means in said article of manufacture further comprising computer readable program code means for causing a computer ~~bit-set~~ BitSet to effect the use of BitSets, said BitSets being selected from the group consisting of User Defined Type BitSets and fast User defined functions.

4. (Currently Amended) The article of manufacture as recited in Claim 1, the computer readable program code means in said article of manufacture further comprising computer readable program code means for causing a computer to effect, ~~if~~ when the relationship in said database comprises one or more levels of inheritance relationships, the aggregation of inheritance ~~bit-sets~~ BitSets through forward and/or backward propagation.

5. (Currently Amended) The article of manufacture as recited in Claim 1, the computer readable program code means in said article of manufacture further comprising computer readable program code means for causing a computer to effect, ~~if~~ when the relationship in said database comprises one or more levels of boolean expression relationships, the generation of boolean expression ~~bit sets~~ BitSets through forward and/or backward propagation.

6. (Original) The article of code means in said article of means for causing a computer manufacture as recited in Claim 3, the computer readable program manufacture further comprising computer readable program code to effect the use of fast User Defined Functions, said fast User Defined Functions being selected from the group consisting of scalar functions and column functions.

7. (Currently Amended) The article of manufacture as recited in Claim 6 ~~the~~ wherein said computer readable program code means in said article of manufacture further ~~comprising~~ comprises computer readable program code means for causing a computer to effect the use of scalar functions.

8. (Original) The article of manufacture as recited in Claim 7, the computer readable program code means in said article of manufacture further comprising computer readable program code means for causing a computer to effect the use of scalar functions, said scalar functions selected from the group consisting of BSGetLength(BITSET), BSInitO, BSInit(BIGINT,BIGINT), BSSetBit(BitSet, BIGINT), BSClearBit(BitSet, BIGINT), BSGetBit(BIGINT), BSAnd(BitSet, BitSet), BSOOr(BitSet, BitSet), BSEquals(BitSet, BitSet), BSMinus(BitSet, BitSet), BSAndEquals(BitSet, BitSet), BSAndIsEmpty(BitSet, BitSet), BSGetBitAt(BitSet, BIGINT), BSGetUpperBound(BitSet), BSGetLowerBound(BitSet).

9. (Original) The article of manufacture as recited in Claim 6, the computer readable program code means in said article of manufacture further comprising computer readable program code means for causing a computer to effect the use of column functions.

10. (Currently Amended) A computer program product comprising a computer usable medium having computer readable program code means embodied therein for causing a relationship to be implemented within a database using BitSets, the computer readable program means in said computer program product comprising computer readable program code means for causing a computer to effect:

A.) ~~Defining~~ defining a database scheme;

B.) ~~Quantify~~ quantify a relationship among a plurality of entities;

~~C.) Populate~~ populate said database with instances of independent relationships among said entities and concurrently populating said database with Bitsets, inserts, deletes and/or changes, there being constraints on the number of keys in the BitSet to allow database integrity thus disallowing incorrect relationship data from being entered into said database. there being associations stored in the form of said Bitsets free from dependency on attribute data values;

D.) ~~Submitting~~ submitting a query for desired information so that said database performs evaluation of said query using said Bitsets;

E.) ~~Database~~ database generates a resultant set;

F.) ~~Resultant~~ resultant set returned to a requestor [-] ;

G.) ~~Repeat~~ repeat any or all steps as needed D through F until a relationship under consideration for said resultant set is exhausted.

11. (Currently Amended) The computer program product as recited in Claim 10, ~~the~~ said computer readable program code means in said computer program product further comprising computer readable program code means for causing a computer to effect an independent query to said database and said data base transforms said query to a ~~bit-set~~ BitSet query.

12. (Currently Amended) The computer program product as recited in Claim 10, ~~the~~ said computer readable program code means in said computer program product further comprising computer readable ~~bit-sets~~ BitSets program code means for causing a computer to effect the use of BitSets, said BitSets being selected from the group consisting of User Defined Type BitSets and fast User defined functions.

13. (Currently Amended) The computer program product as recited in Claim 10, ~~the~~ said computer readable program code means in said computer program product program code means for causing a computer to effect, ~~if~~ when the relationship in said database comprises one or more levels of inheritance relationships, the aggregation of inheritance ~~bit-sets~~ BitSets through forward and/or backward propagation.

14. (Currently Amended) The computer program product as recited in Claim 10, ~~the~~ said computer readable program code means in said computer program product further comprising computer readable program code means for causing a computer to effect, ~~if~~ when the relationship in said database comprises one or more levels of boolean expression relationships, the generation of boolean expression ~~bit-sets~~ BitSets through forward and/or backward propagation.

15. (Currently Amended) The computer program product as recited in Claim 12. ~~the~~ wherein said computer readable program code means in said article of manufacture further ~~comprising~~ comprises computer readable program code means for causing a computer to effect the use of scalar functions.

16. (Currently Amended) The computer program product as recited in Claim 15, ~~the~~ wherein said computer readable program code means in said article of manufacture further ~~comprising~~ comprises computer readable program code means for causing a computer to effect the use of scalar functions.

17. (Currently Amended) The computer program product as recited in Claim 15, ~~the~~ wherein said computer readable program code means in said computer program product further ~~comprising~~ comprises computer readable program code means for causing a computer to effect the use of scalar functions, said scalar functions selected from the group consisting of  
BSGetLength(BITSET), BSInitO, BSInit(BIGINT,BIGINT), BSSetBit(BitSet, BIGINT),  
BSClearBit(BitSet, BIGINT), BSGetBit(BIGINT), BSAnd(BitSet, BitSet), BSOr(BitSet, BitSet),  
BSEquals(BitSet, BitSet), BSMinus(BitSet, BitSet), BSAndEquals(BitSet, BitSet),  
BSAndIsEmpty(BitSet, BitSet), BSGetBitAt(BitSet, BIGINT), BSGetUpperBound(BitSet),  
BSGetLowerBound(BitSet).

18. (Currently Amended) The computer program product as recited in Claim 15, ~~the~~ said computer readable program code means in said computer program product further comprising computer readable program code means for causing a computer to effect the use of column functions.

19. (Currently Amended) A program storage device readable by machine, tangibly embodying a program of instructions executable by the machine to perform method steps ~~for~~ embodied therein for causing a relationship to be implemented within a database using BitSets, said method steps comprising:

A.) ~~Defining~~ defining a database scheme;

B.) ~~Quantifying~~ quantifying a relationship among a plurality of entities;

C.) ~~Populating~~ populating said database with instances of relationships among said entities and concurrently populating said database with BitSets, inserts, deletes and/or changes;

there being constraints on the number of keys in the BitSet to allow database integrity thus disallowing incorrect relationship data from being entered into said database. there being associations stored in the form of said Bitsets free from dependency on attribute data values;

D.) ~~Submitting~~ submitting a query for desired information so that said database performs evaluation of said query using said Bitsets, said Bitsets being of variable length and prepopulated based upon associations, said-query processing being independent of data values, said query for desired information being queries for categorization involving retrieving entities associated with all levels with a single query using column functions for relationships, and Boolean Rule evaluation using a method selected from the group consisting of iteration of recursive queries, confirmation of existence of or count of entities in the relationship;

E.) ~~Database~~ database generates a resultant set;

F.) ~~Resultant~~ resultant set returned to a requestor.

G.) ~~Repeat~~ repeat any or all steps as needed D through F until a relationship under consideration for said resultant set is exhausted.

20. (Currently Amended) The program storage device readable by machine as recited in Claim 19, said method steps further comprising causing said machine to effect an independent query to said database and said data base transforms said query to a ~~bit-set~~ BitSet query.

21. (Original) The program storage device readable by machine as recited in Claim 19, said method steps further comprising causing said machine to effect the use of BitSets. said BitSets being User Defined Type BitSets and fast User defined functions.

22. (Currently Amended) The program storage device readable by machine as recited in Claim 19 , said method steps further comprising causing said machine to effect, ~~if~~ when the relationship in said database comprises one or more levels of inheritance relationships, the aggregation of inheritance ~~bit-sets~~ BitSets through forward and/or backward propagation.

23. (Currently Amended) The program storage device readable by machine as recited in Claim 19, said method steps further comprising causing said machine to effect, ~~if~~ when the relationship in said database comprises one or more levels of boolean expression relationships, the generation of boolean expression ~~bit-sets~~ BitSets through forward and/or backward propagation.

24. (Original) The program storage device readable by machine as recited in Claim 21, said method steps further comprising causing said machine to effect the use of fast User Defined Functions, said fast User Defined Functions being selected from the group consisting of scalar functions and column functions.

25. (Original) The program storage device readable by machine as recited in Claim 24, said method steps further comprising causing said machine to effect the use of scalar functions.

26. (Original) The program storage device readable by machine as recited in Claim 25, said method steps further comprising causing said machine to effect the use of scalar functions, said scalar functions selected from the group consisting of BSGetLength(BITSET), BSInitO, BSInit(BIGINT,BIGINT), BSSetBit(BitSet, BIGINT), BSClearBit(BitSet, BIGINT), BSGetBit(BIGINT), BSAnd(BitSet, BitSet), BSOr(BitSet, BitSet), BSEquals(BitSet, BitSet), BSMinus(BitSet, BitSet), BSAndEquals(BitSet, BitSet), BSAndIsEmpty(BitSet, BitSet), BSGetBitAt(BitSet, BIGINT), BSGetUpperBound(BitSet), BSGetLowerBound(BitSet).

27. (Original) The program storage device readable by machine method steps further comprising causing said machine to effect the use of column functions.

28. (Currently Amended) A process for mapping associations within a database using BitSets comprising the following steps:

A.) ~~Defining~~ defining a database scheme;

B.) ~~Quantifying~~ quantifying a relationship among a plurality of entities;

~~C.) Populate~~ populate said database with instances of relationships among said entities and concurrently populating said database with Bitsets , inserts, deletes and/or changes,

D.) ~~Submitting~~ submitting a query for desired information so that said database performs evaluation of said query using said Bitsets,

E.) ~~Actuating~~ actuating said database to generate a resultant step

F.) ~~Resultant~~ resultant set returned to a requestor.

G.) ~~Repeat~~ repeat steps D through F until a relationship under consideration for said resultant set is exhausted.

29. (Currently Amended) The process for mapping associations within a database using BitSets recited in Claim 28, comprising performing an independent query to said database whereupon said data base transforms said query to a ~~bit-set~~ BitSet query.

30. (Original) The process for mapping associations within a database using BitSets recited in Claim 28, further comprising using BitSets, said BitSets being User Defined Type BitSets and fast User defined functions.

31. (Currently Amended) The process for mapping associations within a database using BitSets recited in Claim 28, further comprising, ~~if~~ when ~~the~~ a relationship in said database comprises one or more levels of inheritance relationships, the aggregation of inheritance ~~bit-sets~~ BitSets through forward and/or backward propagation.



32. (Currently Amended) The process for mapping associations within a database using BitSets recited in Claim 28, further comprising ~~if~~ when ~~the~~ a relationship in said database comprises one or more levels of boolean expression relationships, the generation of boolean expression ~~bit-sets~~ BitSets through forward and/or backward propagation.

33. (Previously Presented) The process for mapping associations within a database using BitSets recited in Claim 30, further comprising using fast User Defined Functions, said Fast User Defined Functions being selected from the group consisting of scalar functions and column functions.

34. (Original) The process for mapping associations within a database using BitSets recited in Claim 33, said method further comprising using scalar functions.

35. (Currently Amended) The process for mapping associations within a database using BitSets as recited in Claim 34, ~~said method steps further comprising scalar functions,~~ wherein said scalar functions are selected from the group consisting of BSGetLength(BITSET), BSInitO, BSInit(BIGINT,BIGINT), BSSetBit(BitSet, BIGINT), BSClearBit(BitSet, BIGINT), BSGetBit(BIGINT), BSAnd(BitSet, BitSet), BSOOr(BitSet, BitSet), BSEquals(BitSet, BitSet), BSMinus(BitSet, BitSet), BSAndEquals(BitSet, BitSet), BSAndIsEmpty(BitSet, BitSet), BSGetBitAt(BitSet, BIGINT), BSGetUpperBound(BitSet), BSGetLowerBound(BitSet).

36. (Original) The program storage device readable by machine as recited in Claim 33, said method further comprising using column functions.

37. (New) An article of manufacture comprising computer usable medium having computer readable program code means embodied therein for causing a relationship to be implemented within a database using BitSets, said BitSets being selected from the group consisting of User Defined Type BitSets and fast User defined functions, said fast User Defined Functions being selected from the group consisting of scalar functions and column functions; and when said computer readable program code means for causing a computer effects the use of scalar functions, said scalar functions are selected from the group consisting of BSGetLength(BITSET), BSInitO, BSInit(BIGINT,BIGINT), BSSetBit(BitSet, BIGINT), BSClearBit(BitSet, BIGINT), BSGetBit(BIGINT), BSAnd(BitSet, BitSet), BSOOr(BitSet, BitSet), BSEquals(BitSet, BitSet), BSMinus(BitSet, BitSet), BSAndEquals(BitSet, BitSet), BSAndIsEmpty(BitSet, BitSet), BSGetBitAt(BitSet, BIGINT), BSGetUpperBound(BitSet), BSGetLowerBound(BitSet); said program code being stored in computer readable memory or storage device, the computer readable program means in said article of manufacture comprising computer readable program code means for causing a computer to effect:

- A) defining a database scheme;
- B.) quantify a relationship among a plurality of entities;
- C.) populate said database with instances of independent relationships among said entities and concurrently populating said database with Bitsets, inserts, deletes and/or changes, there being constraints on the number of keys in the BitSet to allow database integrity thus disallowing incorrect relationship data from being entered into said database, there being associations stored in the form of said Bitsets free from dependency on attribute data values;
- D.) submitting an explicit query for desired information so that said database performs evaluation of said query using said Bitsets, said Bitsets being of variable length and prepopulated based upon associations, said query processing being independent of data values, said query for desired information being queries for categorization involving retrieving entities associated with all levels, with a single query using column functions for relationships and Boolean Rule evaluation using a method selected from the group consisting of iteration of recursive queries, confirmation of existence of or count of entities in the relationship;

further when the relationship in said database comprises one or more levels of inheritance relationships, and/or one or more levels of boolean expression relationships, the aggregation of

inheritance BitSets or Boolean expression BitSets operate through forward and/or backward propagation respectively

E.) database generates a resultant set;

F.) resultant set returned to a requestor;

G.) repeat steps as D through F until a recursive association under consideration for said resultant set is exhausted, said steps for causing a relationship to be implemented within said database using BitSets being free of indexing.

38. (New) The article of manufacture as recited in Claim 37, the computer readable program code means in said article of manufacture further comprising computer readable program code means for causing a computer to effect the use of column functions.